

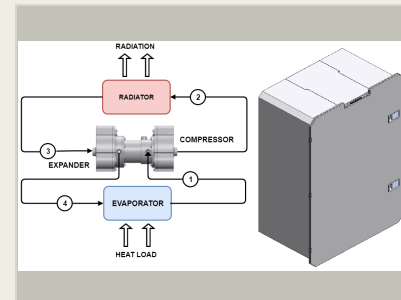
# Vapor Compression Refrigeration System for Cold Storage on Spacecrafts, Phase I

Completed Technology Project (2017 - 2017)



## Project Introduction

NASA is looking for a high efficiency long term food storage system for space crafts. Previous refrigerator/freezer systems developed for this application such as ISS RFR, use thermoelectric thermal control system with overall system COP around 0.36 in freezer mode. Terrestrial cold food storage systems however, utilize a much more efficient vapor compression thermal control systems, making the systems lighter and more compact. Currently, these systems do not have provisions for the load and reliability requirements of space applications, and are also not designed for microgravity operation. To achieve NASA's targets, Air Squared is proposing to develop a scroll driven vapor compression refrigerator/freezer system. It's a highly efficient ( $COP \sim 3.5$ ), lightweight (secondary mass penalty of  $<0.2$  kg) and reliable (oil free & fewer rotating parts) standalone system. Similar to conventional systems, this vapor compression system will include four major components: compressor, condenser, expansion device and evaporator. There are four significant innovations in the vapor compression cycle. For expansion work recovery, a scroll expander will be used to recover power from the expansion process to improve the system performance (Innovation 1). The Air Squared compressor and expander will integrate two stages on either side of the orbiting scroll, to increase the total pressure ratio (Innovation 2), this enhances the performance, without increasing the size or weight of the scroll devices. In order to further reduce the size and weight, both the compressor and expander will be integrated into one hermetic shell with both units driven off a common shaft on either side of the motor (Innovation 3). And last, both the compressor and expander will operate oil-free (Innovation 4). This will remove the cycles operational reliance on gravity while keeping the design compact & lightweight at higher efficiencies.



Vapor Compression Refrigeration System for Cold Storage on Spacecrafts, Phase I Briefing Chart Image

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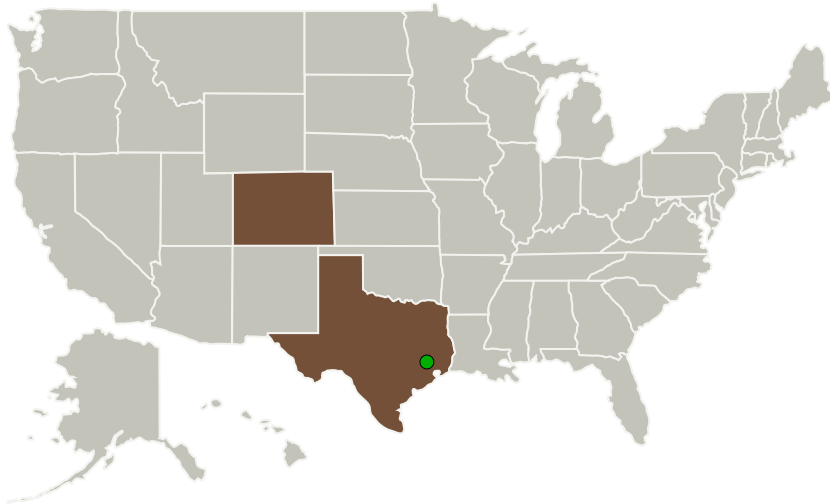
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Air Squared Inc.	Lead Organization	Industry	Broomfield, Colorado
● Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

### Primary U.S. Work Locations

Colorado	Texas
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## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

Air Squared Inc.

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

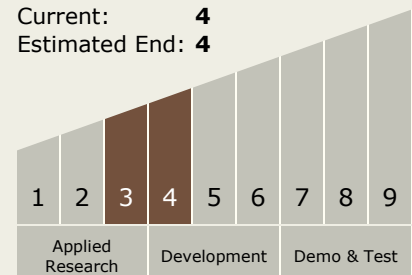
Carlos Torrez

### Principal Investigator:

Kunal Bansal

## Technology Maturity (TRL)

Start: 3  
Current: 4  
Estimated End: 4



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## Images



### Briefing Chart Image

Vapor Compression Refrigeration System for Cold Storage on Spacecrafts, Phase I Briefing Chart Image  
(<https://techport.nasa.gov/image/129619>)

## Technology Areas

### Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.3 Human Health and Performance
    - └ TX06.3.6 Long Duration Health